

Industry 4.0 demands stability, safety and flexibility in ultrasonic welding processes

PLASTIC WELDING

METAL WELDING

CUTTING

CLEANING

SCREENING



What modern ultrasonic generators need to do today to meet the requirements of Industry 4.0 and fully-automatic production processes
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The much-talked-about Industry 4.0 will present production companies with enormous challenges. In addition to automation solutions and communications tasks, repeat accuracy combined with enhanced flexibility, process reliability and stability are in ever greater demand. Even for a batch size of one. The production processes of plastic welding, metal welding and cut'n'seal using ultrasonic technology need generators that guarantee maximum process stability and the greatest possible flexibility in the widest range of applications. This report will show exactly what matters for this.

When production machines are fully automated and networked with one another and also communicating with one another, human beings should ideally no longer intervene. For this, however, all process steps must run with the highest stability, process reliability and repeat accuracy. These extremely complex requirements increase even further in small series, with frequent changes of workpieces, machine settings and numerous tooling changes. They reach the pinnacle in the supreme discipline of "fully automatic manufacturing with a batch size of one". This also applies to the production processes of plastic welding, metal welding and cut'n'seal with ultrasonic technology.

Telsonic ultrasonic technology is ready for Industry 4.0

With its suitability for numerous processes and applications, the proven ultrasonic technology has long been ideal for automated use. It offers solutions for simple and sophisticated welding and cutting tasks on individual workstations as well as in production lines and special-purpose systems. Typical uses include welding of plastics and coloured metals, cut'n'sealing of non-wovens, dividing food into portions and many other applications.



01 Ultrasonic generator MAG

02 Fieldbus modules

In this, the principal focus is on the technological architecture of the ultrasonic generator, which supplies the energy for the welding processes. Industrial bus systems form the basis for data communication. This requires flexibility, as there are various distinct standards in this field. Successful ultrasonic welding requires equipment and a force that presses the oscillating tool onto the workpiece in a controlled way. The ultrasonic equipment comprises the following components:

- Ultrasonic generator: generates the electrical high-frequency vibrations
- Converter: converts the electrical vibrations into mechanical oscillations
- Booster: reinforces (transfers) the mechanical oscillations
- Sonotrode: introduces the mechanical oscillations into the workpiece

The generator's tasks are central

The three components - converter, booster and sonotrode - are mechanically coupled to one other in a fixed manner, and their acoustic resonances are tuned to one another. Pneumatic presses and feeds are normally used to apply a defined force against the workpiece through such a resonance system. In this, the nature and operation of the feed control has a major influence on the welding result. The vibrations are generated in the generator, which converts the normal power supply to high frequency and transfers this high frequency to the converter. The generator thus has a key role to play. Digitalisation of industry is creating more requirements for the generator. But what exactly does this mean? The Swiss pioneer in ultrasonic technology, Telsonic AG, has recently presented a family of fully digital, multi-application generators (MAG). Their functionality and performance spectrum offers an excellent illustration of current and future challenges.

The MAG generator family meets the most modern requirements

With oscillation frequencies of 20-35 kHz and peak power of up to 7.2 kW, the generators offer a broad spectrum for many applications. This makes them especially suitable for system builders and for integration into special-purpose machines. This output is constant across the entire voltage range, independent of fluctuations in the mains supply, which is a feature that is crucial for fully automated production. Even temperature fluctuations leave the MAG generators untroubled. Telsonic's built-in temperature drift compensation guarantees this. The fully digital generators have a USB and industrial bus interface. Bus modules that can be fitted quickly and easily exist for EtherNet/IP, ProfiNet, Sercos3, EtherCAT, Powerlink, Modbus and Profibus. This means the generators can easily be configured and controlled via these modern bus systems. The welding results, such as weld duration, peak power as well as weld and power curves over time, are available at the controller in real time. The configurable results window enables comprehensive process control. This is enormously important for automated production processes in medical technology, for example, where tracking for up to ten years must be guaranteed.

Interconnectivity important for Industry 4.0

Interconnectivity with all other production components is important for the Industry 4.0 concept and for system builders. The Telsonic MAG generator family meets this requirement. These multi-application generators have frequency and data record switchover. With frequency switchover, multiple resonance units can be sequentially operated by one and the same generator. In the process, the frequency search range, start frequency, frequency ramp and other parameters can be saved for up to 16 different resonance units. Together with an HF switchover controlled by the higher-order PLC, this allows the configured frequency parameters to be used for each resonance unit. With data set switchover, the welding parameters and corresponding quality windows can be selected externally via the control lines or the field bus. So, for example, the corresponding weld data set will be loaded when converting to another application or replacing the anvil system. The higher-level controller always selects the right data set, even when a system approaches several weld points at different places with the same tool and the individual welds require different weld parameters and quality windows.

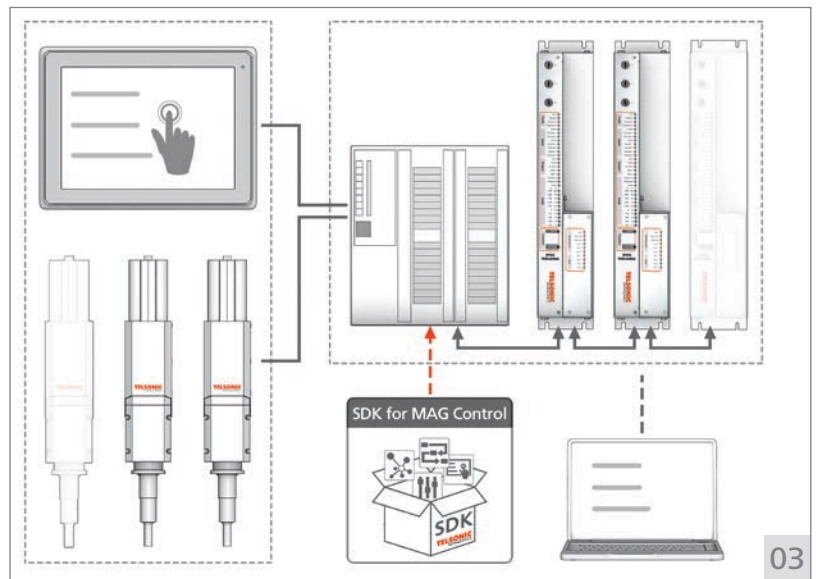
Practical functions simplify use

Generators must also have extremely fast approach ramps. This ensures maximum productivity in fast-moving production lines. For short tooling times, it is an advantage when no frequency scan is needed during a change of sonotrodes. Instead, the generators are ready for operation immediately. In Telsonic's MAG generators, the operating status can be seen, even from a distance, on an easily legible LED status display. Commissioning and maintenance analyses can be easily performed with the Telsonic MAG Control Center software. The fact that the generators have a space-saving design only 265 mm deep makes them well-suited for module-to-module fitting in electrical cabinets that are only 300 mm deep. First of all, integrated active cooling prevents excessive heat build-up. But the low power consumption of the energy-efficient generators also generates less heat. This makes low ventilation distances possible for module-to-module fitting in the electrical cabinet. In addition, power factor correction ensures minimum load on the network. This allows smaller cable cross-sections.

High-quality process control as the connecting element

For controlling the MAG generators, Telsonic offers the TCS5 machine and process controller. Users benefit from an application-ready programmed weld controller with an intuitive user interface, peripheral control, data export, rights management and other functions. Telsonic ultrasonic MAG generators deliver efficiency increases and per-piece cost reductions along with major production reliability. The data availability required for Industry 4.0 projects is guaranteed by modular bus interfaces that also offer high flexibility for integration with higher-level controllers. This helps explain why these ultrasonic generators are already successfully in use in numerous automated production systems in the automotive and packaging industries.

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03 Ultrasonic welding system with PLC controller